1882MNRAS..42..374S

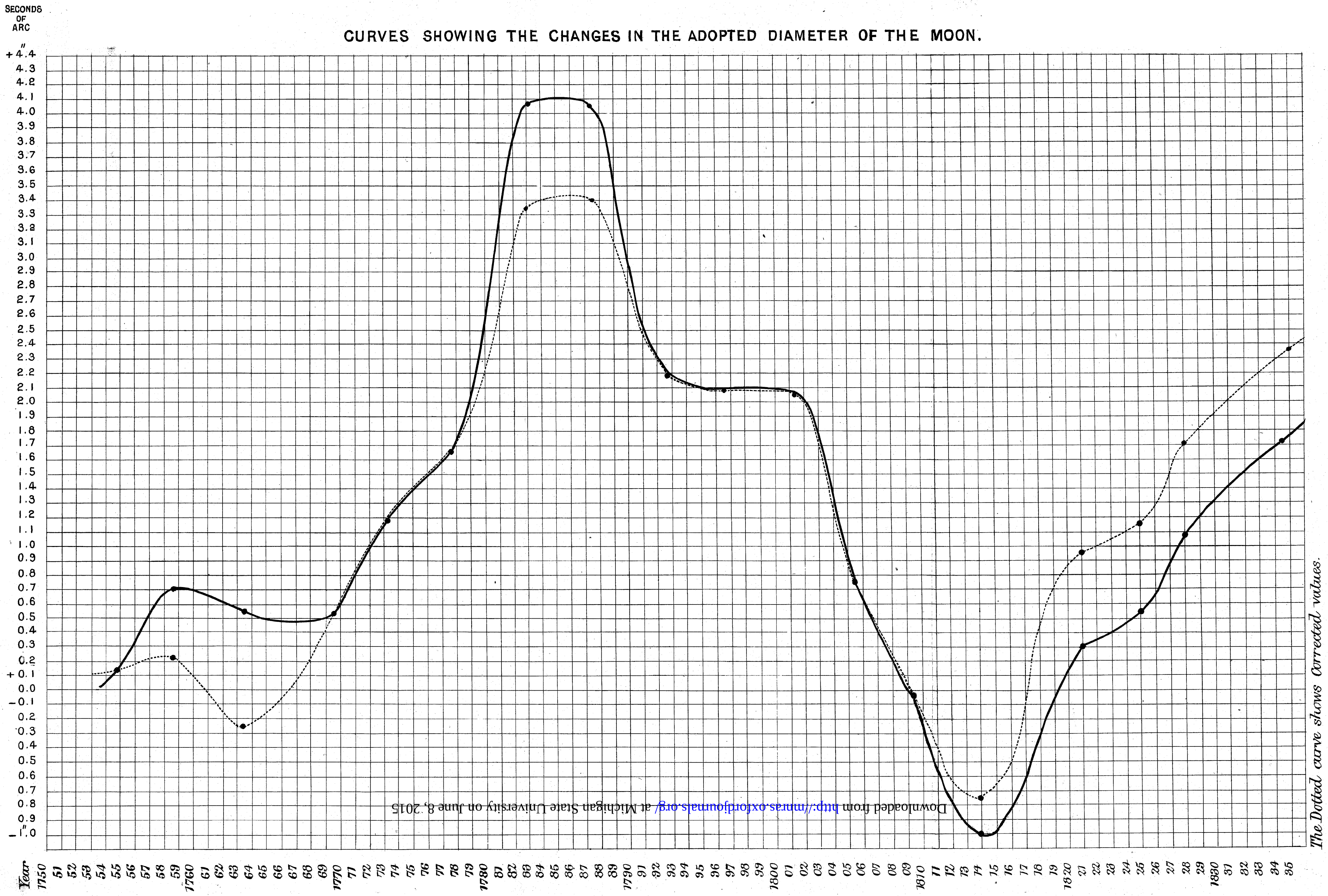
Sun's limb near the point of contact as dark, or nearly as dark, as the outer edge of the planet," then an attempt to obtain a value of the Sun's parallax from a discussion of these observations, on the assumption that the contacts observed refer to the same angular separation of the limbs, will most certainly lead to a value of the solar parallax which is in excess of the true value. If the contacts observed were reversed at the different stations, then the result that would be obtained would be too small. I call attention to the point now, before the transit has taken place, in order, if possible, to prevent the serious confusion and doubt which may arise if any large number of observers are directed to observe a contact of an essentially different character from that which will be observed by the general body of the observers. If this caution is not attended to, it will be possible to obtain different values of the solar parallax by different combinations of the contacts; but of course no one entrusted with the calculations should attempt to combine in one discussion discordant material. It would, however, be far more satisfactory if the collection of this discordant material could be prevented rather than it should be rejected after the transit as worthless for the objects in view.

Curves showing the Changes in the Adopted Diameter of the Moon as given by the Observations in the Greenwich Lunar Reductions 1750–1830. By E. J. Stone, M.A., F.R.S.

The results upon which the curves are based have been extracted from "The Greenwich Lunar Reductions," vol. ii., Section iii., Comparison of Moon's Observed and Tabular Place, pages [1] to [293]. It is from a discussion of the results given in this section that the coefficients of the parallactic inequality were deduced by Sir G. B. Airy, which show an inequality with a period of about forty-six years. The observations have been divided into groups extending over periods of about nine years, identical with those adopted by Sir G. B. Airy. If E_1 and E_2 denote the excess of observed longitudes over tabular longitudes as deduced respectively from the observations of the first and second limbs, then E_1 and E_2 have been extracted directly from Section iii. for all the days on which both limbs were observed in Right Ascension and a North Polar Distance is available for the deduction of the observed longitude. The mean results are given in the following table. The results, divided by 2, will be found essentially the same as those which I have already given in the *Notices* for Dec. 1881, but in the former paper the results for the last year of each period were not included. In the present table the results of the last year of each group are included. The general form of the curve is not, however, altered by this difference in the grouping:—

1882MNRAS..42..374S

CURVES SHOWING THE CHANGES IN THE ADOPTED DIAMETER OF THE MOON.



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1882MNRAS..42..374S

TABLE A.

	Group.	Mean Year.	No. of Obs.	Mean Value of E_1-E_2	Second Set.
1	1750–1759	1754·7	32	+0″·145	+0″·145
2	1755–1764	1758·8	28	+0·709	+0·222
3	1760–1768	1763·4	18	+0·546	−0·248
4	1765–1773	1769·5	16	+0·533	+0·533
5	1769–1778	1773·2	18	+1·184	+1·184
6	1774–1782	1777·8	16	+1·664	+1·664
7	1779–1787	1783·1	16	+4·069	+3·326
8	1783–1791	1787·4	18	+4·053	+3·397
9	1788–1796	1792·7	23	+2·179	+2·179
10	1792–1801	1796·7	23	+2·086	+2·086
11	1797–1805	1801·3	15	+2·053	+2·053
12	1802–1810	1805·3	13	+0·756	+0·756
13	1806–1815	1809·3	12	−0·027	−0·027
14	1811–1819	1814·0	8	−1·008	−0·768
15	1816–1824	1820·9	9	+0·314	+0·954
16	1820–1829	1825·0	17	+0·526	+1·166
17	1825–1833	1828·0	16	+1·083	+1·723
18	1830–1838	1834·7	11	+1·721	+2·361

The errors in the table may of course be affected by the existence of systematic errors in the North Polar Distance, for these observations are involved in the determination of the observed longitudes. There are two very large errors—

1763	Sept. 21	14″·05
1784	28	15·21

The rejection of these two results, and the correction of the results after 1816, August 7, for the slight difference between the adopted diameters before and after that period, lead to the second set of results.

The curves have been laid down from the above results with the mean values of (E_1-E_2) as ordinates, and the corresponding mean times as abscissæ.

On account of the importance of these results, from the use which has recently been made of these old Lunar Reductions, I have not only computed them myself, but I have also had them recomputed independently. I have no doubt whatever about the substantial accuracy of these results. But if correct, they *prove* conclusively that in these old observations, *as reduced*, we cannot pass from observations of the centre as deduced from the first limb of the Moon to observations of the centre as deduced from the second limb of the Moon without the large systematic and variable discordances which are indicated in the table and by the curves.

1882MNRAS..42..374S

Addendum.

In the discussion between myself and Mr. Neison, we are concerned with the observations as reduced in Section iii., and to these I have confined my attention: but if the direct comparison between the times of passage of the diameter over the meridian as observed in Right Ascension did not indicate any such discordances as those found from the longitudes, then we should certainly be able to find the source of the error which has vitated the results as reduced. I have therefore computed the corrections to the provisionally adopted diameter which follow directly from the observations in R.A., as given on pages lxiv and lxv of the Introduction, vol. i. I have, however, found two editions of this Table: one marked *k*, the other marked **k*. My private copy is marked **k*. The Observatory copy is marked *k*. The copy at the Royal Society is marked *k*. The copy at the Royal Astronomical Society **k*. There is no doubt that the copy **k* is the more correct, and my results are derived from that copy. I have had the work done in duplicate, and I have examined it and it is substantially correct. There is only one unit in such inquiries in which the errors can be properly expressed, and that is in seconds of arc and the decimal parts of such a second. The errors in my table are therefore given in such units.

The following are the results:—

TABLE B.

	Group.	No. of Obs.	Corrections to Provisional Diameter.	Excess of Adopted Diameter over Observed.
			″	″
1	1750–1759	34	+4·686	−1·012
2	1755–1764	29	+4·068	−0·394
3	1760–1768	19	+3·762	−0·088
4	1765–1773	18	+4·310	−0·636
5	1769–1778	22	+4·198	−0·524
6	1774–1782	18	+3·150	+0·524
7	1779–1787	16	+2·420	+1·254
8	1783–1791	18	+2·266	+1·408
9	1788–1796	24	+2·590	+1·084
10	1792–1801	24	+3·162	+0·512
11	1797–1805	15	+3·038	+0·636
12	1802–1810	13	+3·276	+0·398
13	1806–1815	12	+4·440	−0·766
14	1811–1819	8	+5·004	−1·330
15	1816–1824	9	+2·798	+0·876
16	1820–1829	17	+2·654	+1·020

1882MNRAS..42..374S

The correction to provisional diameter to find adopted diameter is 3″·674. The results of this table are but slightly affected by any errors in the N.P.D. The corrections are certainly less in amount, but they follow the same general law as those given in Table A.

The deduced corrections to the adopted diameter do not sensibly agree amongst themselves for groups of observations extending over nine years. The errors are systematic. The diameters for a long period about 1783 are about a second of arc less, whilst those about 1765 are about half a second, and those about 1811 about a second of arc, greater than the mean value. It is certain, therefore, that if such corrections should be applied to coefficients of the parallactic inequality deduced from the series of observations, the result must be to strengthen the impression of the existence of a periodic term with a coefficient of about a second of arc and with a period of about forty-six years. And this is just what Mr. Neison found. (See *Notices*, 1880, May, pages 402–405.) Before corrections, such as those indicated, were applied, there appeared to be some indications of a periodic term in the coefficients of parallactic inequality with a coefficient of about a second of arc and a period of about thirty years; but after the application of corrections deduced from the observed durations, a periodic term was supposed to be found with a period of forty-six years.

My position with respect to the discussion is simply as follows: (1.) That I have shown that these old observations, as reduced, are affected with such systematic errors connected with the diameter that they cannot be applied with safety to the determination of values of the coefficients of the parallactic inequality until the source of these errors has been determined and the effects removed from the results given in Section iii. (2.) That the so-called forty-six-year period is certainly mainly due to the same sources of error which directly affect the diameters. (3.) That the introduction of an empirical periodic term with a coefficient of about a second of arc and a period of forty-six years as a *real term* in the expression for the tabular longitude of the Moon is a serious mistake, unless it can be justified by showing that the existence of such a term is a necessary consequence of the theory of gravitation. At present the only evidence in its favour is that such a term would approximately account for the appearance of some systematic discordance in the coefficients of the parallactic inequality as deduced from the results of Section iii. after correction for supposed errors of diameter. But it has been shown that these discordances are largely due to the errors of the diameters themselves; and the introduction of such a term in the longitude would not account for the existence of these errors in the diameter.

Until it has been shown that the results which I have given are substantially in error it will be useless for me to continue any discussion on these questions. They have already absorbed

1882MNRAS..42..378N

much valuable time which I could ill spare, but the introduction of inequalities of long period into the expression of the Moon's longitude which are not necessary is a serious matter, and I have thought it desirable at all events to call attention to what I believe is a case in point.

On a supposed Periodical Term in the Values found for the Coefficient of the Parallactic Inequality. By E. Neison, Esq.

When Sir G. Airy determined the correction to the value of the parallactic inequality, he contented himself with applying a constant correction for error of semi-diameter for each of the two periods 1751–1815, and 1815–1839. But in the investigation undertaken by Mr. Campbell and myself, this was thought insufficient, and it was judged better to apply to each group of observations the correction to the tabular semi-diameter derived from the observations made during the same period. And it was shown that the values of the parallactic inequality when thus corrected strongly indicated the existence of a periodical term with a period of about forty-five years.

It is now objected that these corrections to the semi-diameter of the Moon exhibit a similar periodical term, and the conclusion is drawn that the term shown by the values of the parallactic inequality may have been introduced through the application of these corrections to the semi-diameter, and so be fictitious.

It became necessary to investigate this point.

To establish this objection it is not merely sufficient to show that there exists a periodical inequality in the correction applied for errors of semi-diameter, not even if it be shown that this inequality has a similar period; but it is imperative to show that in the correction applied for error of semi-diameter, there exists an inequality of the same value, period, and epoch as that found in the values of the parallactic inequality, and that when this inequality is eliminated from the corrections applied for errors of semi-diameter, the inequality also disappears from the values found for the parallactic inequality. Nothing less than this will serve to establish the conclusion it has been sought to draw.

From Sir G. Airy's reduction of the Greenwich observations ("Reduction of the Greenwich Lunar Observations," vol. i. pages lxiv–lxv) are derived the following corrections to the tabular semi-diameter of the Moon, divided into the same groups as those used for determining the correction to the parallactic inequality, and for convenience they have been expressed in terms of the same unit as employed by Sir George Airy:—

No.	Group.	No. of Obs.	Corr.	No.	Group.	No. of Obs.	Corr.
i.	1750–1759	34	+·684	v.	1769–1778	22	+·608
ii.	1755–1764	29	+·592	vi.	1774–1782	19	+·392
iii.	1760–1768	19	+·560	vii.	1779–1787	17	+·280
iv.	1765–1773	18	+·648	viii.	1783–1791	18	+·300